Virtual power plants

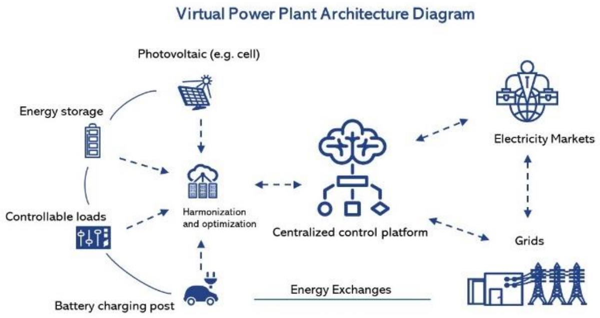
allow for more flexible, reliable, and efficient management of power resources

24.3.14

ADER-DES Consulting Team

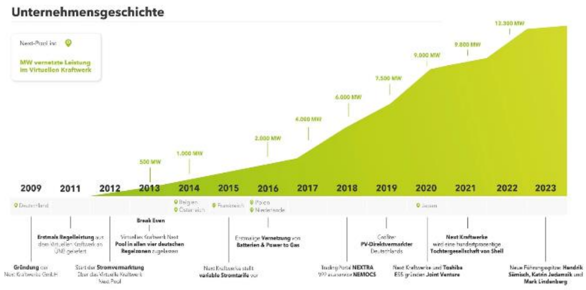
WHAT IS VIRTUAL POWER PLANT

A virtual power plant (VPP) is a decentralized power plant that aggregates power from different technologies using a grid cloud. Its main objective is to enhance power dispatching capabilities and facilitate the activation of free market transactions in electricity. Virtual power plants can be found in the United States, Europe, and Australia. A virtual power plant is not a traditional power plant. Instead, it is a smart energy system that combines various resources, such as adjustable loads, energy storage, microgrids, electric vehicles, and distributed energy sources, among others. This system operates in different spaces, achieving autonomous coordinated optimization and control, and participates in the operation of the electric power system and the trading of the electric power market.



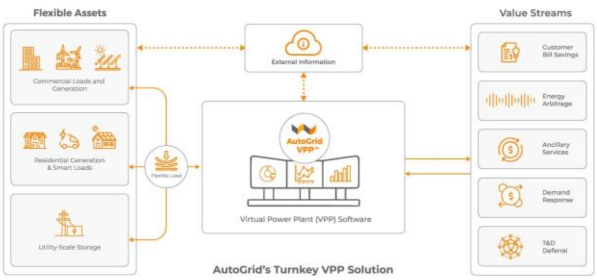
GERMAN

The German power market has a three-stage trading sequence system consisting of 'medium and long term', 'spot', and 'balancing market'. The balancing market has a penalty mechanism to ensure the stable operation of the power system. Using Next Kraftwerke as an example, the company has been operating as the largest virtual power plant operator in Germany for over ten years. It has access to 12.3GW of power resources and profits from both systematic software and technical services. Additionally, it participates in power energy and auxiliary services trading on behalf of resource aggregation in the power market. In 2014, Germany implemented a policy requiring new renewable energy installations over 100kW to be traded similarly to conventional market practices. In 2014, Germany implemented a policy requiring new renewable energy installations (above 100kW) to participate in the electricity market as balancing and settlement units, similar to conventional power sources. This created a demand for power-side resources to participate profitably through aggregation. As a result, better scheduling and bidding strategies for aggregation platforms were needed under the market-oriented mechanism. This revealed the competitive advantages of independent virtual power plant operators in deepening scheduling algorithms and strategies, and led to a rapid growth in the capacity of aggregated resources.



U.S.

The U.S. power market can be divided into two phases: medium and long-term, and spot. In the spot market, electricity and ancillary services are jointly cleared, and real-time and day-ahead dual settlements are implemented to guide the actual operation of power generation and consumption to coincide with the real-time market clearing results. For example, AutoGrid has been deeply involved in power system software technology and system solutions for more than 10 years, and has aggregated more than 8 GW of flexible power resources, helped users understand the regulation and operation rules of the power market, and connected to the power market for electricity and ancillary services. The California government is promoting distributed resource aggregation through the CCA program, and AutoGrid is leveraging the government program to expand the scale of resource aggregation.

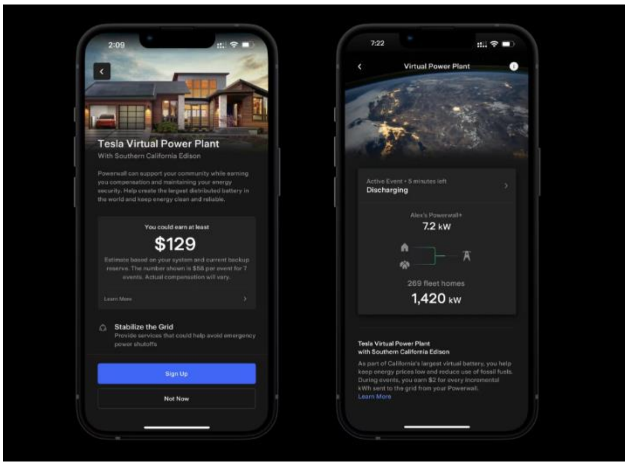


NORTH AMERICA

North America's Virtual Power Plant Aggregates Rich Types of Resources, California's Virtual Power Plant Quantity Leads Significantly. According to the report published by Wood Mackenzie, North America's current virtual power plant project aggregation of multiple resource types, has covered the source, load, storage links, of which the most virtual power plant aggregation of the top three types of resources were intelligent temperature control system, direct control load, energy storage. In terms of aggregation scenarios, the main aggregated resources in industrial and commercial scenarios are directly controlled loads and power generation resources; the main aggregated resources in residential scenarios are photovoltaic and other resources such as energy storage. Geographically, the number of virtual power plants in California is close to 140, with a significant lead.

AUSTRALIAN

The Australian electricity market adopts the mode of "medium and long-term financial contract + unilateral mandatory power bank + ancillary service market", and the ancillary service market adopts a penalty mechanism similar to Germany, and the party responsible for certain grid fluctuations bears the corresponding service compensation cost. For example, based on the advantages of its own products and users' resources, Tesla has rapidly aggregated distributed resources to build the largest virtual power plant project in Australia.In 2019, Tesla, in cooperation with the South Australian government, has installed rooftop solar energy systems and Powerwall home energy storage systems in more than 1,000 low-income households. Today, there are more than 50,000 home communities of solar and Powerwall battery systems and 250 MW of unit capacity across the state. In addition to helping stabilize the grid, Tesla's Virtual Power Plant program in South Australia is helping households save money on electricity costs.



We need to be clear that while virtual power plants have a number of positive implications, they do not mean that they will revolutionize the existing energy supply system, nor do they have the capacity to solve all problems. First of all, virtual power plants are just a more efficient way to integrate distributed generation resources and various forms of available generation capacity or electricity stock, and enable smarter use of electricity, but they cannot solve the root cause of the "shortage". For example, the severe power shortage in Region A just past, is due to severe drought caused by the hydropower system generation capacity plummeted four to five percent, and hydropower in the local power generation structure accounted for more than 80%, superimposed on the high temperature caused by the residents of the power consumption rises sharply, resulting in a huge power gap. This is something that the virtual power plant can not solve. Looking back at the situation, for the huge power gap this, the virtual power plant itself can not do anything to protect industrial production is even more impossible to talk about. After all, even if the virtual power plant has great ability, it is not possible to generate electricity in the void, "change" power to fill the gap.

The same applies to the current global energy and power crisis - virtual power plants are not capable of filling gas shortages or solving fundamental supply-demand conflicts; they only integrate, coordinate and manage, and do not have the ability to address the root causes of the problem. Ultimately, a reliable energy system, regardless of the specific generation mix, whether based on traditional fossil generation or various types of renewable energy, must be able to meet demand. Second, building a virtual power plant goes far beyond the development of a new digital control system and relies on equipment that matches its functionality. For example, in the description of the virtual power plant, the power battery of the new energy vehicle is often regarded as a kind of distributed temporary energy storage device, but in current practice, not all charging stacks are equipped with the function of obtaining power from the on-board battery, and it is naturally impossible to transmit power to the grid. This phenomenon also exists widely in the virtual power plant is included in the concept, but does not yet have the conditions of intelligent management of various types of power equipment. Adapting the current grid to the virtual power plant will require extensive technical upgrades. Considering the size and complexity of the grid, the corresponding infrastructure will be a cumbersome and long-term systematic project.

Web：www.ader-des.com

Contacts：Luna

E-mail：luna@ader-des.com